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Indian Standard

SPECIFICATION FOR PUMPS FOR HANDLING VOLATILE LIQUIDS

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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SPECIFICATION FOR PUMPS FOR HANDLING VOLATILE LIQUIDS

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Indian Standard

SPECIFICATION FOR PUMPS FOR HANDLING VOLATILE LIQUIDS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 20 April 1972, after the draft finalized by the Pumps Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Volatile liquids are used generally in refineries, petro-chemical industries and other chemical industries. In this standard various volatile liquids are specified and the requirements for centrifugal and rotodynamic pumps for use with volatile liquids are laid down.

0.3 By volatile liquids are meant that the liquids pumped at or near vapour pressure, that is, pumping of unstable liquids.

0.4 The technical requirements for centrifugal and rotodynamic pumps covering wide range including definitions, units, classes and type of pumps, effect of viscosity, specific gravity, vapour pressure and other effects on the performance of the pumps, material of construction, salient design features, testing procedure, tolerances and guarantees are already included in IS : 5120-1968*.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard specifies the technical requirements for rotodynamic pumps (like centrifugal, mixed flow, etc) for handling volatile liquids.

2. UNITS, TERMINOLOGY AND CLASSIFICATIONS

2.1 Units, terminology and classifications relating to pumps for volatile liquids shall be as specified in IS : 5120-1968*.

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*Technical requirements for rotodynamic special purpose pumps.

†Rules for rounding off numerical values (*revised*).

3. CHARACTERISTICS OF VOLATILE LIQUIDS

3.1 The liquid, operating at or near vapour pressure, is said to be volatile and it exhibits one or more of the following characteristics:

a) High pressure (for example, propane and butane at ambient temperature);
b) High temperature (for example, boiler feed water and heater drains; process hydro-carbons);
c) Low pressure (for example, steam condensate); and
d) Low temperature (for example, cryogenic and refrigerated ammonia).

4. NOMENCLATURE

4.1 Nomenclature of the parts used in rotodynamic pumps for volatile liquids shall be as given in IS : 5120-1968*.

5. MATERIAL OF CONSTRUCTION

5.1 It is recognised that a number of materials of construction are available to meet the needs for pumps handling volatile liquids. But the typical material of construction for volatile liquid pumps are all cast iron, all cast steel or all stainless steel, all bronze or bronze-fitted. Table 7 of IS : 5120-1968* shall be used for guidance.

5.1.1 Wrought materials, such as for shaft may be either of similar composition to the castings used or suitable shaft protection should be provided against corrosion. Most of the parts are primarily castings.

5.2 Gaskets, Seals and Packings — Gaskets, seals and packings used for pumps for handling volatile liquids shall conform with those specified in IS : 5120-1968*.

6. DESIGN

6.1 Prime Mover — The requirement of the prime mover and method of driving shall be as given in IS : 5120-1968*.

6.2 Balancing — The major rotating parts like impellers, the balancing drums, etc shall be suitably balanced so as to prevent undue vibrations under normal operating conditions. In case, where limiting the undue vibrations is essential, the purchaser shall specify the limits.

6.3 Types of Horizontal Pumps — Horizontal pumps covered under the standard may be broadly classified as horizontally split and vertically split.

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*Technical requirements for rotodynamic special purpose pumps.

6.3.1 Horizontally split pumps shall not be furnished if the following conditions are specified:

a) Pumping temperature of 200°C or higher, and

b) Flammable or toxic liquids with specific gravities less than 0·7 at pumping temperature.

6.3.2 One and two stage pumps with discharge nozzle 150 mm and larger and multistages pumps may be horizontally split for services outlined in **6.3.1** with specific approval of the purchaser.

6.4 Casings

6.4.1 The pressure casing shall be of carbon steel or alloy steel in the form of casting, forgings, rolled or welded plates for handling liquids under any of the following conditions:

a) Pumping temperature of 175°C and higher;

b) Flammable or toxic liquids with vapour pressures greater than 1 atm measured at pumping temperature, or at 35°C whichever is higher;

c) Flammable or toxic liquids with specific gravities less than 0·825 at pumping temperature, together with a maximum discharge pressure in excess of 10·5 kg/cm^2; and

d) Maximum discharge pressure in excess of 17·5 kg/cm^2. Cast iron construction for the casing for pumps having flammable and toxic services shall only be provided if specified in the data sheet.

6.4.2 Pressure casing shall be of such thicknesses as will be suitable for the maximum discharge and hydrostatic test pressure and pumping temperature with a 3·5 mm minimum corrosion allowance.

6.4.3 Throat bushings, if used, shall be held securely in place where the shaft passes into the stuffing boxes.

6.4.4 Pumps shall be provided with suitable means, like eyebolts, lugs, etc, to facilitate dismantling. When jack screws are provided as means of parting contracting faces, the mating face shall be counterbored to receive the jackscrew where malting offers a possibility of a leakage joint or improper fit.

6.4.5 The stuffing boxes shall be faced to accommodate the use of mechanical seals.

6.4.6 Horizontal pumps with vertically split cases shall be designed to permit removal of the impeller, shaft, bearings, etc without disassembling the suction and discharge piping and prime mover.

6.5 Nozzles and Miscellaneous Connections

6.5.1 All pump casings preferably shall have suction flanges designed for the same pressure as discharge flanges to permit testing under the required full test pressure. If bored and tapped nozzles are standard, they may be used for size 40 mm and smaller. Flanged nozzles shall be used for pipe size 50 mm and larger.

6.5.2 The vapours liberated shall be properly vented unless the pump is made self-venting by the arrangement of the nozzles.

6.5.3 Preferably no tapped openings shall be furnished in the suction or discharge volutes or other high velocity areas of the pump unless they are essential for the pump operation. The inquiry and order should so state if drain, vent, or pressure gauge connections are desired.

6.5.4 To withstand vibration, all connections for seal cage, seal oil lines, drains, etc, shall be at least ½ P size (*see* IS : 554-1964*) for pumps 65 mm and smaller. The pipe size shall be at least ¾ P for pumps 75 mm and larger.

6.5.5 The pipe threads when required shall be tapered in accordance with IS : 554-1964*.

6.5.6 Steam jacketing around suction nozzle shall be provided in case of fluid having crystallizing properties at a particular pump temperature to prevent the liquid from being crystallized during operations.

6.6 Suction and Discharge Flange and Facing

6.6.1 Flanges for pumps shall conform to the requirements of IS : 6392-1971†. Non-standard flanges shall not be furnished unless approved by the purchaser.

6.6.2 If the manufacturer's standard pattern entails flange thickness and a diameter greater than that of the rating specification, the heavier flange may be furnished, but it shall be faced and drilled as specified. Flanges shall be full or spot faced on the back.

6.6.3 Cast iron flanges shall be flat-faced.

6.7 Wearing Rings

6.7.1 The casing shall be provided with wearing rings, while in respect of the impellers, this would depend upon the design. Unless both surfaces are 400 HB or over, opposed wear surfaces of hardenable material shall have a hardness difference of at least 50 HB (*see* IS : 1500-1968‡).

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*Dimensions for pipe threads for gas list tubes and pressure tight screwed fittings (*revised*).

†Specification for steel pipe flanges.

‡Method for Brinell hardness test for steel (*first revision*).

6.7.2 Renewable wearing rings shall be held in place by an approved method, such as screwing against rotation, flanged and screwed, or press fit and locked with pins, or tack welded at three or more points.

6.8 Running Clearance — Sufficient running clearance between wearing rings and between other moving parts shall be such so as to prevent seizure under the operating conditions of temperature, suction conditions, character of the fluid handled, and the expansion and galling characteristics of the ring material.

6.9 Shaft and Shaft Sleeve — To minimize the wear on the shafting, a shaft sleeve or a hard facing of the shaft surface with accurate machining may be provided.

6.10 Bearings

6.10.1 Radial bearings of standard design (ball, roller or sleeve type) shall be provided. Suitable thrust bearings shall be provided, as required.

6.10.2 The bearings shall have a rated life for continuous operation at the rated pump conditions of 25 000 h and shall, in no case, be less than 16 000 h at maximum axial loads at rated speed.

6.10.3 In the case of oil lubricated bearing, the bearing oil temperature shall not exceed 80°C based on specified operating conditions and 43°C ambient.

6.10.4 Where water cooling is required, either water jackets formed by cored castings or cooling coils may be used.

6.10.5 Bearing housing shall be effectively sealed against the entrance of water or dust and shall have drain at the bottom of each housing.

6.11 Sealing Arrangement

6.11.1 Stuffing boxes having conventional packings shall be of sufficient depth so as to prevent leakage within the pump casing of the fluid being handled.

6.11.2 Ample space shall be provided for the packing replacement without removing or dismantling any part other than the gland and the seal case if split.

6.11.3 The use of suitable packings without involving lubrications shall be adopted.

6.11.4 Wherever possible, the use of mechanical seals is recommended.

6.11.4.1 If mechanical seal cannot be provided, water jacketing, blead off connection or oil or grease seal may be provided.

6.12 Couplings — The couplings between the pumps and the power drive shall be suitable flexible type, when a solid shaft driver is used on vertical pumps or in pull-back type of horizontal pumps equipped with a mechanical seal, spacer coupling of adequate length shall be provided to allow replacement of seal or other components without disturbing the piping connections and prime mover.

7. DIRECTION OF ROTATION

7.1 The direction of rotation of pumps is designed clockwise or anticlockwise as observed when looking at the pump shaft from the driving end.

7.2 The direction of the rotation shall be clearly marked either by incorporating an arrow in the casing or by a separate metal plate arrow securely fitted to the pump.

8. ACCESSORIES

8.1 In addition to essential and optional accessories specified in IS : 5120-1968* provision shall be made for fitting auxiliary piping, such as indicated below:

a) Stuffing box cooling connections shall be provided when temperature of volatile liquid exceeds 95°C;

b) Bearings shall be provided with cooling connections to their temperature below 80°C;

c) Vacuum equaliser connections shall be provided when pumping from suction vessels under vacuum;

d) Sealing connections should be provided to lantern rings in stuffing boxes;

e) Balancing liquid leakage connection should be provided in case of multistage pumps with balancing disc; and

f) For pumping temperatures of 180°C or higher base plates shall be designed for centre line support of pump casing so as to maintain alignment. Pump supports of this type shall be provided with supplimental cooling, if required to maintain satisfactory alignment.

9. SUCTION LIMITATIONS

9.1 Suction limitations affecting the performance of volatile liquid pumps are the same as those specified in IS : 5120-1968*.

9.2 NPSH available should be adequate and more than NPSH required.

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*Technical requirements for rotodynamic special purpose pumps.

10. FACTORS AFFECTING PUMP PERFORMANCE

10.1 Factors affecting pump performance are the same as those specified in IS : 5120-1968*.

11. DESIGN FEATURES FOR PERFORMANCE

11.1 The pumps shall have suitable features properly designed to ensure satisfactory performance. In particular, the design features, such as the following shall be incorporated:

a) In case of more than one duty points, the performance range is to be indicated and the prime mover should be of sufficient power to take entire load in this range;
b) For working in parallel, pumps should be with stable head capacity characteristics; and
c) To prevent overheating of multistage pumps at full close pressure, an orifice suitably designed is recommended on the discharge side to maintain certain minimum flow.

12. INFORMATION TO BE SUPPLIED BY THE PURCHASER AND THE SUPPLIER

12.1 The information to be supplied by the purchaser and the supplier shall be the same as those specified in IS : 5120-1968*.

13. PUMP TEST

13.1 Pump tests shall be the same as those specified in IS : 5120-1968*, however, cent percent testing should be done.

14. DETERMINATION OF PUMP PERFORMANCE

14.1 The determination of pump performance for volatile liquids shall be in accordance with the method specified in IS : 5120-1968*.

15. GUARANTEES

15.1 Guarantee for Workmanship and Material — The pumps shall be guaranteed by the manufacturer against defects in material and workmanship under normal use and service, for a period of at least one year but not exceeding one and half years after date of despatch.

15.2 Guarantee of Performance — The supplier shall indicate the working range of the pump and the efficiency of the pump shall be guaranteed at a specified point of rating only and shall not be guaranteed to cover the performance of the pump under conditions varying therefrom or for a suitable performance for any period of time. If the purchaser so desires, the manufacturer shall guarantee the non-overload of the prime-mover for variation in the head in the working range. In the case of pumps, where acceptance cannot be conducted on the liquid for which the pump is designed, the manufacturer shall indicate the liquid performance of the pump based on the results of the tests conducted by him on the pump with water and interpolated as specified in IS : 5120-1968*.

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*Technical requirements for rotodynamic special purpose pumps.

However, in those cases, the manufacture shall guarantee the performance of the pump with water for the specified range.

16. TOLERANCES

16.1 In all commercial acceptance tests of pumps, a certain tolerance shall be allowed to the manufacturer on his guarantee to cover inaccuracies of the equations for discharge, errors of observation and unavoidable minor inaccuracies of the instruments employed.

16.2 A tolerance of 2·5 percent shall be permissible on the discharge.

16.3 The percentage pump efficiency shall be not less than the specified value by more than 2·5 percent. This tolerance may be raised to 5 percent in the case the prime-mover does not get overloaded.

17. GENERAL REQUIREMENTS

17.1 The general requirements for the pump for volatile liquid shall be as given in IS : 5120-1968*.

18. MARKING

18.1 Every pump shall have a name plate indicating:

a) Name and address of the pump manufacturer;
b) Type, size and serial number of the pump; and
c) Speed, total head capacity and corresponding pump input.

18.2 The pump may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

19. PACKING

19.1 The pumps may be packed to avoid damage during transit and according to the best trade practices available.

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*Technical requirements for rotodynamic special purpose pumps.

(*Continued from page* 2)

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